DOCUMENT RESUME

ED 349 024 IR 054 146

AUTHOR Matier, Michael W.; Sidle, C. Clinton
TITLE Developing a Strategic Plan for Library Space Needs through 2010.
PUB DATE Apr 92
NOTE 33p.; Paper presented at the Annual Spring Conference of the Society for College and University Planning, Mid-Atlantic Region (Philadelphia, PA, April 8-10, 1992).
PUB TYPE Reports - Evaluative/Feasibility (142) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS College Libraries; Copyrights; Crowding; Electronic Publishing; Facility Guidelines; *Facility Planning; Facility Requirements; Higher Education; Information Storage; Library Collection Development; Library Facilities; *Long Range Planning; *Needs Assessment; Prediction; *Research Libraries; *Space Utilization; Technological Advancement; Trend Analysis
IDENTIFIERS *Cornell University NY; *Electronic Text

ABSTRACT

A 20-year strategic plan for library space has been developed at Cornell University, a private research university which also serves as the land-grant university for the State of New York. Two basic approaches to analyzing space needs were used. The first was the conventional analysis, where collections and user space needs are projected into the future based on estimated growth rates and modified national library standards for space utilization. This analysis focused on primary user populations, collection growth rates, user/reader and service space, and use of the Library Annex and compact shelving. A working group of appropriate library, information technology, and planning and research staff estimated the impact of relevant technologies on the conventional projections over the 20-year planning period. Factors that influenced estimates include the commercial viability of materials produced in digital formats; copyright constraints; user acceptance of digital storage of information; relative costs of buying, storing, and retrieving electronic materials; and the phased implementation of technology. Based on these analyses the university adopted four strategic planning criteria to serve as the starting point for all library space planning through 2010. Figures appended to the paper graph projected library space increases; the comparative costs of digital and remote storage; projected increases in space needs; and historical and projected space growth rates. Appended tables present data for critical need libraries, including current projected volume equivalents; current and needed reader space; current and desired use of remote storage and compact shelving; and current and projected space needs. (KRN)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☐ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

ED349024

Developing a Strategic Plan for Library Space Needs Through 2010*

Michael W. Matier
Associate Director

and

C. Clinton Sidle
Director

Institutional Planning and Research
Cornell University
440 Day Hall
Ithaca, NY 14853-2801

Presented at the Annual Spring Conference
of the Society for College and University Planning
Mid-Atlantic Region
Philadelphia, PA -- 8-10 April 1992

Running Head: Developing a Strategic Plan for Library Space

*The authors are indebted to the following individuals who contributed to the planning processes leading to this strategic plan and who read earlier versions of this paper. From the Cornell University Library we were assisted by: Alain Seznec, The Carl Kroch University Librarian; Ross W. Atkinson, Assistant University Librarian; Catherine L. Murray-Rust, Assistant University Librarian; John A. Hoffman, Library Capital Projects Manager; and Howard W. Curtis, Head of the Library Information Technology Section, A. R. Mann Library. From Cornell Information Technologies, we were assisted by M. Stuart Lynn, Vice President for Information Technologies and Lynne K. Personius, Assistant Director of Scholarly Information Systems.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Michael W. Matier

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

BEST COPY AVAILABLE

1205/1140

Abstract

With the need for university research libraries to maintain a scholarly historical record and acquire the expanding body of knowledge necessary to support instruction, research and service, their holdings must inevitably increase. However, given advancing technology, a library's foot-print need not grow into perpetuity. The media in which these libraries' holdings are maintained can be expected to change, permitting space efficiencies. Whether these alternatives to additional space will become operative or cost effective during the next twenty years is still an open question. This paper describes the development of a strategic plan for library space at one university in the midst of this uncertainty and should interest all engaged in maintaining and developing library resources.

Developing a Strategic Plan for Library Space Needs Through 2010

The very essence of a research library necessitates that it constantly grow. The production of "new" knowledge is clearly an exponential function, with the growth in printed materials escalating at ever increasing rates. Though the Cornell University Library does not endeavor to keep fully abreast of this explosive growth, as a repository of accumulated knowledge to support the instructional, research and service needs of undergraduates, graduate students, faculty and staff, it will always experience growth in its collections.

Given current and future advances in both sophisticated and mundane space saving technologies, the foot-print of the library will not necessarily need to grow into perpetuity. It is expected that the media in which those holdings are maintained will change to permit greater space efficiencies, but these alternatives to constructing or renovating additional space may or may not become fully operative and/or cost effective during the twenty year planning horizon under consideration in this analysis of space needs.

The Problem

Cornell University is a private, co-educational, nonsectarian research university, which also serves as the land-grant university for the State of New York. The institution is supported by a unique combination of private and public funds. The privately funded schools and colleges (the endowed colleges) in Ithaca are the College of Architecture, Art and Planning; the College of Arts and Sciences; the College of Engineering; the School of Hotel Administration; the Law School; the Samuel Johnson Graduate School of Management; and the Graduate School. The endowed units of the medical division are part of the New York Hospital-Cornell Medical Center in Manhattan. In addition, four state-supported colleges are operated by the university on behalf of New York State pursuant to statute or contractual arrangements under the general supervision of the trustees of the State University of New York. These units, based in Ithaca, include the College of Agriculture and Life Sciences; the College of Human Ecology;

the School of Industrial and Labor Relations; and the College of Veterinary Medicine. The New York Agricultural Experiment Station at Geneva is a unit of the College of Agriculture and Life Sciences, and its departments are integral parts of the college. The Ithaca components of the institution serve a student body comprised of approximately 12,600 undergraduates and 5,600 graduate and professional students.

The net growth of the Cornell University Library's collection has been gradual over the institution's 125 year history. The current collection has been arrived at through a combination of annual acquisitions of purchased new materials, donations and the discarding of materials no longer needed. Most recently, collections have been growing at a net compound rate of approximately 2.2 percent per year. Conversely, the net incremental additions of physical space to house these collections, to accommodate the users of these materials and to provide space for the staff necessary to support them have occurred in spurts as indicated in Figure 1. Given the nature of the difference between adding volumes to a library and the construction or renovation of new library space to house these increases, this is not a surprising phenomenon. Nevertheless, it does lead to periodic space crises, such as the one currently faced at Cornell.

• • • • • • • • • • • • • • • • • •

Insert Figure 1 about here

• • • • • • • • • • • • • • • • • •

The space crisis is not just related to the future growth of the collections, but also to the current operating and physical condition of the library units. Even under the most conservative of estimates, many of the libraries within the Cornell University Library system are housed in seriously aging facilities and operating with real space deficits. Their ability to satisfactorily manage current operations and to accommodate future growth in collections is constrained by one or more of the following phenomena.

1. **Insufficient space**. For example, in many of the libraries the collections have grown to the point where the whole collection must be shifted and re-shelved on an annual basis to squeeze in those volumes added during the year. In the Industrial and Labor

Relations (I&LR) Library, materials on book stacks are shelved at almost twice the recommended density. Mann Library was designed in 1929, built in 1952, and is now 38 years old without ever having had a significant addition or renovation.

2. **Floor loading limits**. Many of the libraries are housed in buildings not designed with floor loading capacities sufficient for library collections. For instance, while the Fine Arts Library appears to have more than enough room to grow for quite some time, the fact that book stacks must be positioned along and above load bearing walls seriously constrains its ability to add to its collection. In the Music Library, floor loading limits have required housing 65 percent of the collection in the basement, space that is non-contiguous with the remainder of the collection and the library services, thus closing that portion of the collection to general patron access. In the Math Library, the floors sag from overloading which occurred in the 1970s.
3. **Lack of adequate fire, safety and security systems**. The basement level of the Engineering Library lacks a sufficient number of means of exit. Though the Mathematics Library is serviced by a sprinkler system, it has no smoke detectors. The old self-supporting stack structure in Mann Library is hazardous since fire could buckle the exposed steel structural uprights.
4. **Nonexistent or severely limited disabled access**. In several of the libraries, the disabled are unable to browse even the lower levels of stacks because elevators or ramps are unavailable to make it possible for them to traverse from floor to floor.
5. **Deficient climatic controls**. Lack of climatic controls exposes users, staff and the collections to wide swings in temperature and humidity in the Math, Fine Arts, Music, Engineering, Veterinary and Mann Libraries. This not only causes staff and patron discomfort, but also seriously accelerates the aging of the collections.
6. **An infrastructure inadequate to take advantage of technological advances**. Electrical loads and outlets in several of the libraries have been stretched to their limits by the addition of equipment to support the online catalog and other user facilities.

Antiquated electrical infrastructures in these libraries pose a serious constraint to installation of advanced library technologies.

Nevertheless, while the current space crisis and the growth of collections are a given, where and how materials should be housed are not as clearly and rigidly defined. Patricia Battin, in her Introduction to *Campus strategies for libraries and electronic information* (1990) describes the crux of the political problem we faced quite well:

> "The research library relies heavily upon labor-intensive operations to manage the printed materials that constitute the knowledge base and demands equally labor-intensive efforts from its users. Approximately 90 percent of the information needs of the academic and research programs depend on this essentially nineteenth-century information system. It coexists with an emerging twenty-first century information system that currently serves only 10 percent of those needs. The coexistence contributes to a frenetic schizophrenia among students and faculty, who expect the efficiency and convenience of electronic facilities from traditional library services and the comprehensive literature coverage of traditional library collections from electronic systems. That the technical potential to provide services that combine the best of both systems exists, in the abstract, creates unrealistic expectations. The problem is compounded since the bulk of scholarly literature still resides only in traditional print formats." (p. 3)

Given a desire to limit and control additional building on the university's central campus and the advent of promising developments in electronic space saving technologies, it became imperative for the university to conduct a comprehensive analysis of the library's space needs that addressed both of these issues. Our challenge was to arrive at a workable, strategic solution. On the one hand, the strategy we crafted would need to meet with the approval of the university's Board of Trustees who were generally of the opinion that the "virtual library, i.e., a library that provides access to electronic and print materials from many sources, both local and remote," (Dougherty and Hughes, 1991, p. 4) was already distinctly

possible to implement. On the other hand, we had to work with the university's library and information technology staffs who were more keenly aware of the limits of technology, and who held different views of the pace with which these technologies would become operative and how these technologies would impact and be accepted by the library's user populations.

In February of 1990, the Provost initiated a process whereby each of the individual library's needs were evaluated in a collaborative effort by the librarians, central library staff, and the Office of Institutional Planning and Research. At the outset of this process, the University Librarian identified 9 of the 16 Ithaca campus libraries in the university system as having critical space problems. These libraries were the primary focus of our investigations and deliberations. The remaining libraries had either recently undergone renovation or construction, or were unlikely to undergo significant changes other than modernization. Included among the latter were the recently renovated Law, Africana and Hotel libraries, the Uris Library which is considered to have a steady-state collection, and the Physical Sciences Library which requires only a reconfiguration of its current space. The critical need libraries include Engineering, Fine Arts, Industrial and Labor Relations, Management, Mann, Mathematics, Music, Olin, and Veterinary Medicine.

The Conventional Solutions

Early in the effort, it became apparent that two basic approaches to analyzing space needs were required. The first was the standard, or conventional, approach where collections and user space needs were projected into the future based on estimated growth rates and modified national library standards for space utilization. The second (described in the next section) looked at the potential impact of space saving technology on these conventional projections. The conventional analysis was conducted for each of the libraries (see Appendix I for details) and focused on the following variables: primary user populations, collection growth rates, user/reader and service space and use of the Library Annex and compact shelving.

Space needs were calculated by employing traditional library standards. The statutory libraries conformed to the standards established by the State University of New York (SUNY), while the endowed libraries followed the more generic national standards established by Leighton and Weber (1986). The Leighton and Weber standards were often customized in our deliberations to fit the local situation, especially when they proved to be unrealistic or far too liberal for one of Cornell's libraries. For example, the industry standard for shelving density is 10 volumes per square foot, but, depending on the discipline and the particular needs of the particular Cornell library, most used densities between 12 and 20 volumes per square foot. Likewise, the national standard for staff and service space is assumed to equal 25 percent of the combined collections and user/reader space necessary, and assumes each constituent library is a full service library. However, since many of the libraries' back-office services are provided centrally, the projections for staff and service space in our projections typically incorporated an amount between 10 percent and 15 percent of combined collection and reader space. The SUNY standards were not modified in making projections for the statutory libraries because the plans for these libraries were previously approved by SUNY. The findings from our analysis of conventional solutions are summarized below.

Collection growth

Collection growth was based on the rate of increase during the most recent five year period. However, future growth was estimated on the basis of an annual incremental volume increase, not on a percentage growth rate that would have compounded the need for additional space over the twenty year planning horizon. This decision was made not only because of a desire to be conservative on demands for new space, but also because a compound growth rate simply can not be expected in light of acquisition budgets that will grow in a more modest linear fashion even though the cost of library materials in either paper or digital formats can be expected to rise in a non-linear fashion as has been the case for much of the past ten years. The effect of these two factors will gradually drive down the library's average annual growth rate from about 2.2 percent to 1.6 percent by the year 2010. Hence the

total collection is expected to grow from 6,664,122 volume equivalents in 1989 to 10,488,081 in 2010 for the entire University Library system. Volume equivalents are defined as space equivalents of printed volumes for other library materials stored in the collection. Table 1 shows the anticipated growth for each of the critical need libraries in the system.

• • • • • • • • • • • • • • • • • •

Insert Table 1 about here

• • • • • • • • • • • • • • • • • •

User/Reader Space

The relevant user populations of undergraduates, graduate students and faculty were, in most cases, assumed to remain constant at their present levels throughout the twenty year time frame as the university has committed itself to hold total enrollment and faculty numbers at about their current levels. National standards typically call for reader spaces for 25 percent of an undergraduate population. However, the proportion of user/reader space required in each constituent library varies greatly depending on the mix of undergraduate, graduate and faculty users, the prevalent mode of instruction utilized by the units supported by each library, as well as by external accreditation requirements. For example, space for 75 percent of the primary user population of the Law Library is required to meet accreditation standards for Law Schools, up to 50 percent is required in the Music Library to support listening requirements and heavy use of materials by secondary user populations, while only 20 percent is required to meet normal demands in the Engineering Library.

The projected user/reader space need is the area where there is the most flexibility within the conventional analyses, even though the estimates are conservative given current usage patterns and accreditation requirements. Currently, the library system provides 4,784 reader spaces for over 20,000 undergraduate, graduate student and faculty users, or approximately one space for every 4.2 users. The targeted number of reader spaces is 6,441, one for every 3.2 users, an increase of 35 percent. Nevertheless, if the university were to make a commitment to providing alternative or remote "study spaces," particularly for

undergraduates, it would be possible to scale back the projected need for user/reader space in the libraries. Table 2 summarizes the user/reader projections for each of the critical need libraries in the system.

• • • • • • • • • • • • • • • • •

Insert Table 2 about here

• • • • • • • • • • • • • • • • •

Remote Storage and Compact Shelving

Rather than projecting a "worst case scenario" for space needs, most of the libraries made space projections realizing the need for expanding their use of both remote storage and compact shelving to house collections. Though clearly advantageous for saving central campus space, there are sacrifices to be made with each of these means of storage. Remote storage--in a facility similar to the current Library Annex--works best with materials that are not frequently in circulation, as it is expensive to pay the additional operating costs associated with the additional staff and access/transportation services necessary to make material available to users on demand. Additionally, it is better for holdings in a storage facility to be low use materials since there is typically up to a 24 hour wait between when the user makes a request and when it can be delivered. (This does not consider the potential effects of advanced technologies that will be discussed later.) Compact shelving is a minor improvement in accessibility over remote storage in that it permits a central campus home for low use material. However, user access is somewhat time consuming because the shelving is mechanized, though patrons can at times still browse and select materials on their own. Nevertheless, the cost of these shelving units is higher than for traditional shelving and the floors must constructed to handle about twice normal library floor loadings.

The degree to which each of the constituent libraries anticipated utilizing these strategies varied. For example, "older" materials in many of the sciences are not as crucial to research and instruction as historical documents are in the arts, humanities and social sciences. As a consequence, the Physical Sciences and Engineering libraries have anticipated heavy use

of remote and compact storage, while the Music and Fine Arts libraries made much more conservative estimates for using these strategies as a means for saving space.

Overall, the analysis showed at least 12 percent and 18 percent of all library holdings will be remote and compact shelving respectively by the year 2010. As with the projected need for user/reader space, there is flexibility in the total amount of the collection housed in a remote facility, provided there is sufficient capacity. However, the greater the proportion of holdings held remotely the greater will be the need to improve access and delivery services.

Compact shelving and remote storage are a must as the university limits growth on central campus. The current Library Annex will need to be augmented. The results of our analysis shows a demand for a facility to house at least 940,000 volumes by the year 2010, but the ultimate need will depend on the extent and success of other space saving strategies the university adopts, particularly digital storage technology. The library will also need to invest in additional staffing, as well as in improved access and delivery systems to function adequately in a larger remote storage facility that will serve a larger user population. Table 3 summarizes the current and desired use of compact shelving and remote storage by each of the critical need libraries in the system.

• • • • • • • • • • • • • • • • • •

Insert Table 3 about here

• • • • • • • • • • • • • • • • • •

In summary, the conventional analysis showed that there is a current space deficit of 163,400 NASF throughout the entire library system located in Ithaca. By the year 2000, there will be a need for an additional 82,545 NASF, and yet another 88,366 NASF by 2010. Table 4 summarizes the projected needs for each of the critical need libraries.

• • • • • • • • • • • • • • • • • •

Insert Table 4 about here

• • • • • • • • • • • • • • • • • •

The Potential Impact of Technology

Undoubtedly the next 15 to 20 years will herald changes in the way libraries acquire, archive, catalog, arrange and circulate their holdings. For the past twenty years, the most aggressive use of such technologies have been in back office functions such as acquisitions and cataloging (Battin, 1990). In the future it will be in the domain of direct user services that technology will have the most significant impact on the way in which the library conducts its business. Holdings themselves will undergo significant change as an increasing proportion of material becomes available in digitally encoded forms. Such changes will have a significant impact on how materials are stored, and the way in which services are delivered. Each of these new developments hold important implications for space planning.

That much is clear. What is far less clear is the pace of change to be expected, with respect to both technology and cost. The pace of introduction of technologies will be governed by the status and maturity of technologies at any given time, their applicability and relevance to the world of research libraries and the availability of appropriate materials in digitally encoded form either from commercial sources or through direct digitizing of material. The introduction of technologies will also depend on cost, the availability of funding and the cost/effectiveness of the particular technology in comparison to other operative space saving methodologies. Presently, the most promising technologies are not mature, and where experimental prototypes are available, their costs are understandably not yet fully determined. The primary focus of the technology component of our investigation was to try to estimate when appropriate technologies will become both available and affordable.

To attempt to identify the relevant technologies and estimate their impact a working group of University Library staff, Information Technology personnel and representatives of the Office of Institutional Planning and Research met regularly throughout the summer and early fall of 1990. Working in subgroups and as a committee of the whole we identified the emerging technologies that we believed would most directly and significantly impact on our need for space to house collections. We did as much empirical research as we could into the

relative strengths and weaknesses of emerging space saving technologies, paying particular attention to their possible acceptability to our user populations. We then attempted to speculatively model their impact on space and their anticipated cost effectiveness.

The technologies available to the Cornell University Library to temper the need for additional space include some--such as microforms, the online catalog, interlibrary loan, facsimile transmission and remote storage--that are already heavily in use and some that are potential candidates for significant expansion. Some of these, such as microforms, never lived up to original expectations. Microforms certainly save space, but they have been an abysmal failure with respect to user acceptability. Others, such as interlibrary loan, have maximized their present value with current technologies, but could be expanded with advances in networking and digital storage. Newer technologies, such as optical scanning, full-text imaging and the mass storage of digitized information in either optical or magnetic media are either beginning to be or soon will be used within the Cornell Library. However, in estimating the potential impact of these nascent technologies, several factors come into play, particularly within the twenty year planning horizon under consideration.

Commercial Viability

The development of new technologies and their delivery systems, as well as their implementation within research libraries will be evolutionary, not revolutionary. The pace of technological advances with respect to materials originally produced in digital formats will be linked to and driven by commercial viability. Thus a markedly different pace of change will be realized by the various libraries in the Cornell University Library System. Libraries focusing their collections on law, management, medicine, science and engineering materials will in all likelihood experience the fruits of technological advances before the libraries responsible for the social sciences, arts and humanities.

This is not to say that Cornell has adopted a passive approach, waiting for the various technologies and implementation strategies for research libraries to be developed elsewhere. In point of fact, there are two, pioneering, bell-weather projects now under way at Cornell that

explore the implementation of new technologies. In cooperation with Xerox and the Commission for Preservation and Access (Xerox/CPA), Cornell is in the process of digitizing a collection of old, fragile, out-of-copyright monographs in order to test the feasibility of digitizing endangered materials, electronically storing the images and creating a cost-effective means of providing paper copies on demand to users.

Additionally, in concert with the American Chemical Society, BellCore, Chemical Abstracts and OCLC, the A. R. Mann Library is engaged in the Chemical Online Retrieval Experiment (CORE) to make available on the Cornell campus a database of electronic journal literature in the chemical sciences, and to investigate what computer and networking systems and what types of user interfaces will be required to make the "electronic journal" useful for researchers. The CORE database will consist of both the textual and graphic components of approximately seven-year runs of 20 important chemistry journals published by the American Chemical Society, together with the texts of several chemistry reference works and textbooks.

Source of Publications

Throughout the foreseeable future, technological developments in publishing will probably be restricted to publishers in industrialized countries. However, many of Cornell's current holdings and annual acquisitions are published in developing countries. Because of the major capital investments involved in "retooling," publishers in developing countries will doubtless be very slow to join the ranks of those marketing digitized publications.

Copyright Constraints

Though concerns about copyright protection have already constrained publishers from moving ahead full force into the digitization of materials, copyright and intellectual property concerns per se will not indefinitely hold up the pace of technological advancements. However, publishers can be expected to set comparatively higher prices on "user fees" for electronic materials than they will on other media because of the greater potential for unauthorized duplication and distribution. User fees could take the form of either a "site license," or a charge imposed for each page printed, or a combination of the two. Our own

university's Legal Counsel offered an opinion that was echoed in large measure in conversations with library personnel familiar with this issue. Their conclusion is that, except in certain limited areas, the scope of copyright protection is the same for digital information as it is for information stored on other media. Thus, if the library plans to reformat materials in digital form, it must choose materials not protected by copyright, or be prepared to enter contractual arrangements with publishers, similar to those found in the software industry. As yet, there is no clear precedent in the industry for this activity, and it will be several years before charging is standardized in a manner consistent and acceptable to publishers and universities.

User Acceptance

Of all the issues surrounding the choice of digital versus paper storage of information, the effect on the library's service program is the most speculative. In converting paper holdings to digital formats the effects on users will need to be carefully monitored. One key issue is whether researchers and other users will utilize their workstations to browse and read text, or insist on the provision of paper copies. To date there is little information as to whether this utility will be enhanced or impaired, though the Xerox/CPA and CORE projects will provide useful insights.

Putting information into electronic forms will not necessarily, in all cases, increase or improve accessibility. Given that the current library depends quite heavily on user self-help in utilizing the facility (thus, keeping down costs), the electronic library could shift the responsibility (and thus the cost) of much of the information retrieval process from the users to the library and the university. This assumes the current practice of distributing "user costs" as widely as possible will continue, otherwise the university could pursue the controversial option of charging patrons more directly for the use of certain library services. To wit, the university becomes responsible for installing the appropriate infrastructure on and off campus to support the delivery of electronic information and the library becomes responsible for providing new retrieval methods and an effective delivery system.

Thus, while it can be expected that in the long run digital technologies will enhance the library's service to its users, great care will need to be taken in making this transition.

Cost Considerations

Converting to, or buying electronic materials--and all the requisite storage and retrieval devices necessary to support their use--may currently be more expensive than building paper document collections, both with respect to initial capital expenditures and ongoing operating costs. However, this will certainly not always be the case.

The major constraint on just how much space can be saved through the utilization of technology and when it will be cost/effective to pursue these strategies is not likely to be the technologies themselves, nor even the legal considerations surrounding them. Rather, what will constrain pursuing technological solutions to library space problems will be the rate of development of the technologies, determining how best to implement the use of technologies while still satisfying the needs of users, and the multiplicity of costs associated with developing, acquiring, maintaining and using digitized research library materials.

The initial experience gained from the Xerox/CPA and CORE projects will provide a basis for estimating both the space savings and the costs associated with incorporating these technological advances. Because of the cutting edge nature of these projects, few institutions are in a better position than Cornell in investigating these issues. Thus, in attempting to understand long range cost and space saving potential, we used the early experience of these projects as the gauge for making projections. As these are early experiences, the conclusions reached and discussed below should be considered both tentative and conservative.

We investigated the potential costs and space savings for each of the respective projects, and, in the case of the Xerox/CPA project, modeled a 10 year comparative cost curve for storing 100,000 volumes either in a digitized format or in new space constructed off-campus. However, given the very tentative nature of the cost estimates available for implementing the strategy being tested in the CORE project on a large scale basis, and their reliance on current

technological capacities which are highly conservative, we did not extrapolate these costs and space savings into the future.

The Xerox/CPA project was much more amenable to projections. It is anticipated that digitizing old, out-of-copyright monographs will prove to be an excellent storage medium for deteriorating materials. Exactly how digitization might affect user access will remain a question until the experiment comes closer to its conclusion.

Although this process is designed for endangered materials, in order to estimate when digital storage might become affordable for the general collection, we developed a cost model assuming that the technology could be applied to any volume currently held in the system. The costs of this process were generalized for converting 100,000 volumes, and compared to the costs of housing a like number of volumes in a newly constructed remote storage facility. Since the costs associated under either of these alternatives will change differently over time, the study group projected the costs for storing 100,000 volumes under both scenarios in each of the next 10 years. Figure 2 charts the net present value of the one-time conversion costs and the continuing costs for both storage alternatives for each year through the year 2005.

• • • • • • • • • • • • • • • • • •

Insert Figure 2 about here.

• • • • • • • • • • • • • • • • • •

Before drawing any conclusion from this depiction, it must be emphasized that the model is rough and parameter sensitive, thus illustrating only the very gross relationships. Nonetheless, the model does provide some insights and suggests that the cost of converting to digital storage approaches the cost of constructing remote storage around 1996. However, the model does not include the cost of converting volumes still protected by copyright (about 80 percent of the university collection). Further calculations showed that if by the year 2000 every volume in digital storage were charged $20 in user fees annually, the two alternatives would cost approximately the same. This suggests that by the turn of the century--and possibly sooner--the costs of the technology and copyright permission will become affordable for large

scale application. Based on these preliminary findings, digitizing 1 million volumes in this fashion could provide a net savings of roughly 77,000 NASF. These savings would be fragmented and unevenly distributed throughout the library system, but would provide some spare capacity in the 21st century, or sooner if the technology matures and becomes cost/effective earlier.

Nevertheless, it is important to note that simply selecting 1 million volumes without copyright protection from the library collection would be difficult. The largest group of the collection never protected by copyright are government publications, but since these are cataloged by subject this would make it a very time consuming, and dollar intensive, process to select them for digitization. Furthermore, materials selected for digitization should of necessity be used infrequently. Digitized information can be read on the proper equipment, but anyone wanting to read more than a few paragraphs will likely want to have a paper copy. Documents of low use can be printed on demand on those rare occasions when they are needed, but paper copies should be maintained for higher use materials.

The Phased Implementation of Technology

Technology has already significantly affected research libraries, though for the most part its focus has been on improving operations. The next decade, however, will herald a shift toward the increasing use of electronic technologies for the storage and distribution of, and access to, full-text documents that may either have been originally published in electronic form or have been converted from paper documents. Even though the traditional library will continue to grow and flourish, there will be a steadily increasing emphasis on the "electronic library." The pace of introduction of this electronic technology will have a direct bearing on space planning insofar as electronically stored documents already occupy far less space than their paper counterparts, and the gap will only widen over time.

Facilitating the establishment of the electronic library will be an enormous undertaking not only testing the limits of technology and of the ability to develop delivery systems, but also stressing the very foundations of how research libraries are used, the adaptability of laws

governing proprietary interests in intellectual property, and the ability to foster rapid change within constrained budgets.

As such, Cornell plans to introduce technology into the Library in several phases, proceeding from prototypes through feasibility, development and implementation. Different areas of application will proceed through these phases in an overlapped and staggered manner, the timing dependent upon inhibiting and facilitating factors that will vary among application areas. The staggered overlapping of these activities will result in a net growth of technological advances throughout the decade, and our assumption is that their combined effect will diminish the need to create additional space around the turn of the century.

For each separate area of activity there will be four phases of implementation that each technological development must pass. First, equipment and procedures will be prototyped and experiments will be carried out to test the ideas, technical feasibility, user acceptance, and architectural configurations of different technologies. The product of this phase will be a conceptual model and strategy for implementation. Under normal circumstances this process will last from one to two years. Second, based on the information gathered during the first phase, the university will conduct feasibility studies to test the model against reality. The conceptual model will be evaluated against the previously mentioned inhibiting and facilitating factors to determine the feasibility of the model and to refine the concept for implementation. This phase can be expected to take one to three years depending on how much overlap there is with the first phase. Third, the model will be developed into a deliverable system. This will take anywhere from one to three years, depending on what needs to be developed in-house, what can be obtained commercially and what can be done collaboratively with other institutions and professional organizations. Fourth, the general production and broad-based implementation of the technology will be the final phase, lasting one to three years.

Thus, even under the best of circumstances--setting funding aside--it will take from five- to seven-years to compete the phased implementation cycle for each application of

technology. Though every effort will be made to compress the five- to seven-year cycles for each new technological advance, we felt it would be unlikely that the additive effect of new technology will have a significant aggregate impact on space needs until around the turn of the century.

It must also be emphasized that there are significant risks as well as rewards involved with implementing these types of technological advancements within the library system. Foremost are the general risks involved in being a pioneer in any endeavor. Being the first, or leading the way, necessitates moving along a path and expending valuable human, financial and physical resources that may in the end produce a product that will not adequately meet needs. Additionally, even if the research and development process leads to what appears to be a viable alternative, until the system is put in place there are no guarantees that the capital investment will actually prove to have been all that it was intended. The example of microfilm is not one to be taken lightly. This was a technology that was reasonably expected and projected to meet a major demand in miniaturization and space saving, yet its user-un-friendly-ness has seriously limited its efficaciousness.

Advanced electronic technologies can be expected to temper the need for additional space for libraries. However the question of when it will become cost/effective to pursue technological solutions on a large scale cannot be fully answered since the technologies have not yet fully matured nor are the service implications of pursuing the use of technology fully understood. The Xerox/CPA and CORE projects will provide experience to better understand some of these issues, but not conclusively for another one to two years. Nevertheless, we concluded that it is important for the university to continue to invest in the development of technological solutions such as these in order to be positioned to take advantage of these and other developments as soon as they prove feasible.

It was our considered opinion that the technology will mature, service problems will be better understood and resolvable and the costs will become affordable by the turn of the century. However, there is so much uncertainty regarding the development of technology that

it would be imprudent to develop a strategy for the next decade with technology as the linchpin. Rather, it would be better to pursue the technology option vigorously and leave the door open for it to have an earlier impact.

Conclusion: The Strategic Planning Criteria

Because of the need both to maintain a scholarly historical record of the past and to acquire a continually expanding body of new knowledge in the wide array of fields in which instruction and research are conducted at Cornell, its library collections must inevitably increase. Nevertheless, as a result of the investigation of the conventional solutions to our library space needs and our deliberations concerning the potential impact of advancing space saving technologies, we concluded the need for ever increasing central campus space for the library system would not be necessary. Hence, the university embraced the following strategic planning criteria to serve as the starting point for all individual library space planning activities through 2010:

1. **Steady State Strategy**. Given the uncertainty surrounding advanced electronic technologies, the university should supply central campus space to meet the needs of the endowed, critical-need libraries through the year 2000, and then beyond 2000 consider central campus space at steady state. The additional space would address the current space deficit as well as the projected collection growth until 2000. Beyond 2000, collection growth will be managed through technology and remote storage.

   In contrast to the endowed libraries, SUNY has already approved plans to meet the central campus needs for space of the statutory libraries through the year 2011. However, as in the case of the endowed libraries, beyond the year 2011 the university will assume that the central campus space will be at steady state, and that collection growth will be absorbed through technology and remote storage. Even with this assumption, the Mann and I&LR libraries may still need to reassess the scale of their current plans in light of state funding decisions.

Even if technology were to arrive much sooner, it would not be enough to overcome the problems associated with the current space deficit and immediate growth needs until the new technologies could be employed. Thus it was agreed reasonable to adopt a strategy that addresses these issues directly while at the same time positioning the institution to take advantage of technology at the earliest possible time.

2. **Remote Storage**. Contingent to making the above strategy operational is the need for a new, expanded or additional Library Annex. In following such a strategy the current Library Annex facility will need to be augmented to meet significantly increased demand throughout the twenty year planning horizon. In addition, faster and more "user-friendly" access and delivery services will need to be developed to meet the needs of an expanded user population and a larger portion of the collection being stored off-site.

In following these first two strategies, a total of 315,253 NASF in net incremental, additional central campus space will be necessary for reaching steady state. However, 266,911 NASF of this space is already fully or partially funded through the Olin and statutory library projects, leaving only an additional 48,342 NASF beyond what is already planned for central campus, excluding the need for additional remote storage. Any new construction, however, will release space for other university purposes.

Figure 3 depicts the space savings realized in following this path as compared with: a "worst-case" scenario that would not increase the use of the Library Annex or compact shelving beyond current levels; and with growth anticipated purely through the conventional analysis relying exclusively on the Library Annex and compact shelving to save space.

• • • • • • • • • • • • • • • • • •

Insert Figure 3 about here.

• • • • • • • • • • • • • • • • • •

Another way of viewing the projected growth need under this scenario is to view it in the context of Figure 4. From 1870 through 1970 the library system's space grew at an

annualized rate of approximately 5 percent per year. From 1970 through 2010, employing the strategies suggested above, the library system's space will grow at an annualized rate of only 1.5 percent per year.

• • • • • • • • • • • • • • • • • •

Insert Figure 4 about here.

• • • • • • • • • • • • • • • • • •

Two additional strategies will also be considered as plans are developed for individual library construction and renovation through 2010.

3. **User/Reader Space.** As mentioned in the section on the conventional analysis, the projected user/reader space need is the area where there is the most flexibility in the defined space needs. Many students use the library as a quiet study hall while not using library services or materials. Thus, if the university were to commit to providing alternative or remote study spaces, particularly for undergraduates, it would be possible to scale back the projected user/reader space needs in some of the libraries.
4. **Library Consolidation.** Although not discussed above, several solutions have been proposed to consolidate libraries that would also slightly scale back the need for additional space. Plans were underway for a combined Engineering-Mathematics Library to be housed within and about a renovated Sage Hall, however the overall costs associated with renovating and expanding this historic facility have made it presently impractical. Preliminary discussions have also been held concerning combining the Management and I&LR libraries, and the Music and Fine Arts libraries. There are, however, obstacles to each of these consolidations, including faculty expectations of proximity and convenience. There are also problems with the ownership of space, historic preservation considerations and with funding. Nevertheless, these opportunities for consolidation must be explored.

References

Battin, P. (1990). Introduction. In C. Arms (ed.), *Campus strategies for libraries and electronic information* (pp. 2-10). EDUCOM Strategies Series on Information Technology. Bedford, MA: Digital Press.

Dougherty, R. M. and Hughes, C. (1991). *Preferred futures for libraries: A summary of six workshops with university provosts and library directors.* Mountain View, CA: The Research Libraries Group, Inc.

Leighton, P. D. and Weber, D. C. (1986). *Planning academic and research library buildings.* Second edition. Chicago: American Library Association.

Figure 1.

Net incremental library space increases.

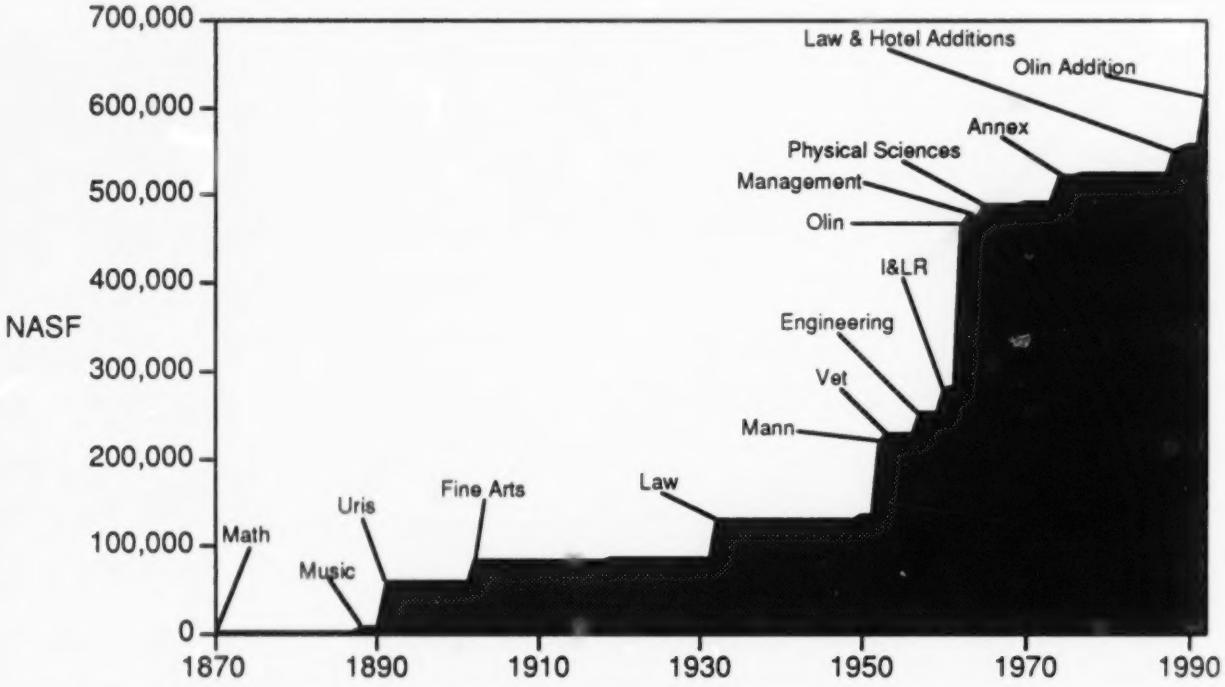

Figure 2.

Comparative costs of digital and remote storage of 100,000 volumes.

(Dollars in thousands)

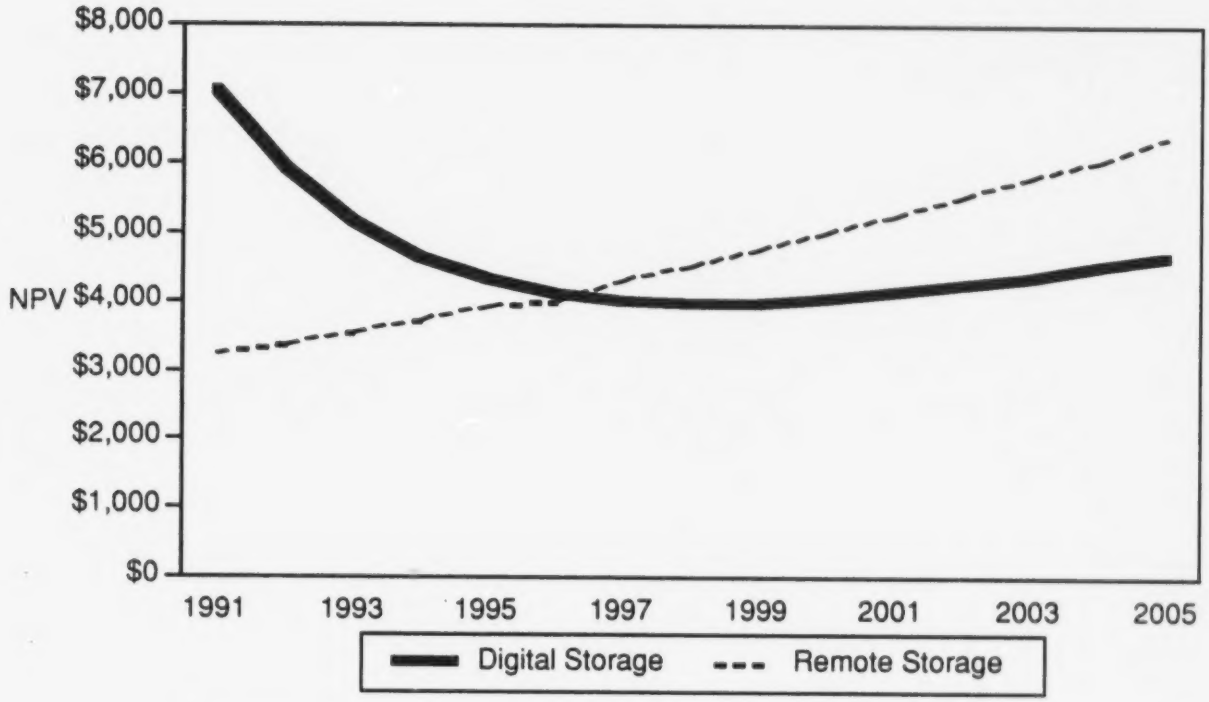

Figure 3

Projected net incremental library space needs.

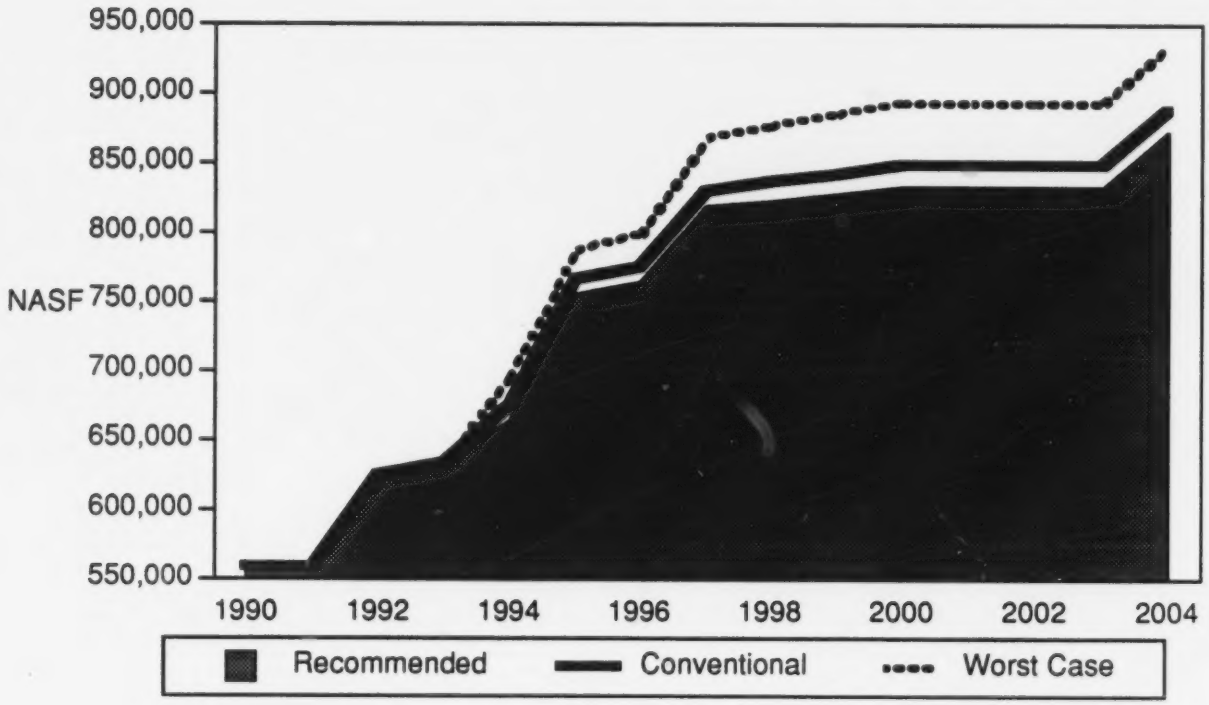

Figure 4

Library space growth rates.

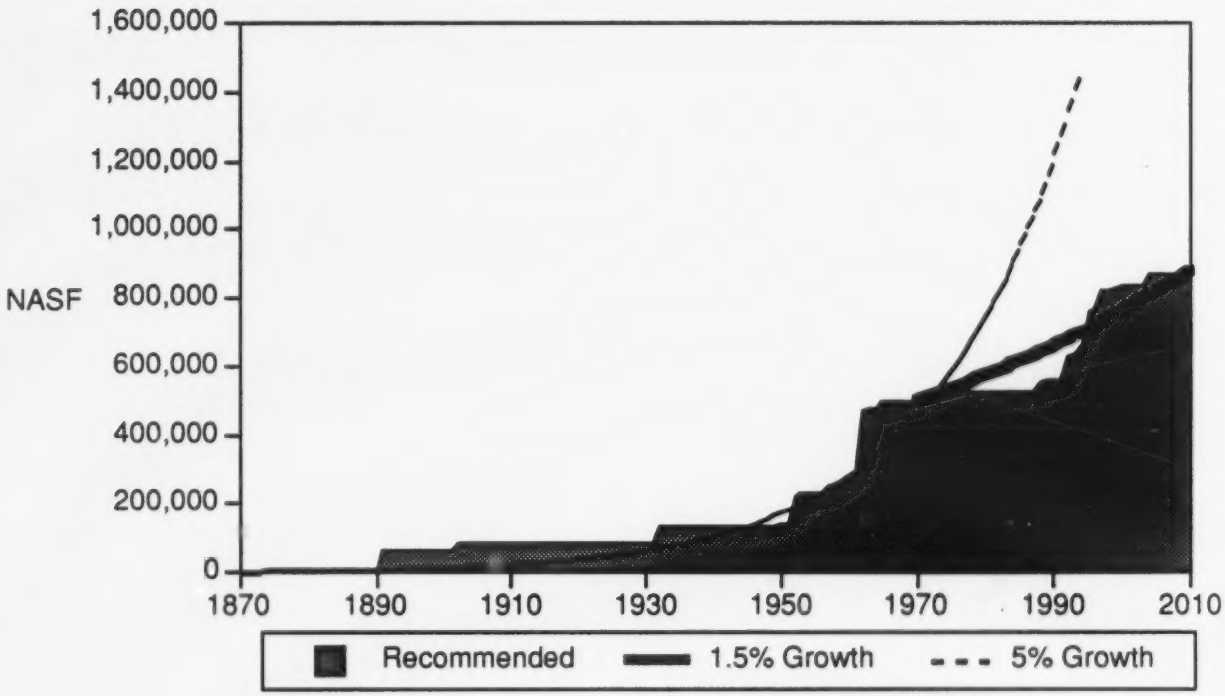

Table 1

Current and projected total volume equivalents for the critical need libraries.

Library	Collection in 1989	Collection in 2010
Endowed		
Engineering	406,421	635,289
Fine Arts	157,818	238,897
Management	181,540	287,408
Mathematics	41,826	118,293
Music	108,039	185,552
Olin	3,489,947	5,302,201
Subtotal	4,385,591	6,767,640
Statutory		
I&LR	579,526	1,097,985
Mann	842,270	1,454,743
Veterinary	92,757	173,248
Subtotal	1,514,553	2,725,976
Total Critical Need	5,900,144	9,493,616
Total University	6,664,122	10,488,081

Table 2

Current and needed reader spaces for the critical need libraries.

Library	Current Reader Spaces	Needed Reader Spaces
Endowed		
Engineering	282	720
Fine Arts	246	370
Management	187	290
Mathematics	28	102
Music	73	77
Olin	963	1,235
Subtotal	1,779	2,794
Statutory		
I&LR	210	395
Mann	708	1,147
Veterinary	117	135
Subtotal	1,035	1,667
Total Critical Need	2,814	4,471
Total University	4,784	6,441

Table 3

Current and desired use of remote storage and compact shelving in the critical need libraries.

Library	Current	2000	2010
Endowed			
Engineering			
% holdings in remote	40%	31%	28%
% holdings in compact	0%	30%	26%
Fine Arts			
% holdings in remote	5%	8%	12%
% holdings in compact	5%	5%	5%
Management			
% holdings in remote	15%	15%	15%
% holdings in compact	0%	10%	20%
Mathematics			
% holdings in remote	0%	10%	15%
% holdings in compact	0%	20%	30%
Music			
% holdings in remote	4%	5%	10%
% holdings in compact	0%	10%	20%
Olin			
% holdings in remote	10%	10%	12%
% holdings in compact	0%	30%	30%
Statutory			
I&LR			
% holdings in remote	16%	13%	8%
% holdings in compact	0%	42%	39%
Mann			
% holdings in remote	7%	5%	4%
% holdings in compact	0%	0%	0%
Veterinary			
% holdings in remote	3%	6%	10%
% holdings in compact	0%	25%	33%

Table 4

Current and projected NASF space needs in the critical need libraries.

Library	Current Space	Current Need	Need in 2000	Need in 2010
Endowed				
Engineering	24,037	44,084	48,240	54,892
Fine Arts	25,400	26,176	28,522	31,583
Management	13,384	19,282	21,277	22,554
Mathematics	3,484	8,421	11,664	14,177
Music	11,680	14,635	16,624	17,978
Olin	183,061	223,965	255,425	290,061
Subtotal	261,046	336,563	381,752	431,245
Statutory				
I&LR	28,699	63,200	74,300	84,200
Mann	80,000	127,565	147,537	171,609
Veterinary	11,400	16,659	20,341	24,201
Subtotal	120,099	207,424	242,178	280,010
Total Critical Need	381,145	543,987	623,930	711,255
Total University	523,787	687,187	769,732	858,098